# Collisions with Passenger Cars and Moose, Sweden

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**Abstract:** The number of collisions between motor vehicles and moose is increasing in many countries. Collisions with large, high animals such as moose cause typical rear- and downward deformation of the windshield pillars and front roof, most pronounced for small passenger cars; the injury risk increases with the deformation of the car. A strengthening of the windshield pillars and front roof and the use of antilacerative windshields would reduce the injury risk to car occupants. (*Am J Public Health* 1986; 76:460–462.)

## *Introduction*

In Sweden, the number of reported road accidents involving large wildlife and motor vehicles has increased five-fold during the 1970s[1,2] and now constitute about one-third of the accidents on the state road net (i.e., excluding rural roads). It can be calculated that about one driver out of 10 with an annual driving distance over 20,000 km will collide with a moose once during his lifetime.[3] Previous injury reducing measures aimed at preventing contact between car and moose have had little success.[3–6] Another approach is to focus on injury reducing measures in the construction of the cars. The mechanism of a moose collision is special since the body of the moose, because of its long legs, will strike directly against the windshield pillars, the windshield, and the front roof of passenger cars (see Figure 1). Vans and pick-up trucks are less common in Sweden than in the United States. Data reported here cover *only* passenger car collisions.

## *Methods*

In the official statistics, 900 passenger car-game accidents with personal injuries were reported during 1979–80. Six hundred and fifty direct moose-car collisions were selected for study. Collisions with other animals and all accidents involving a secondary collision with another vehicle or fixed object are thus excluded. Of these 650 accidents, all 86 with severe[1] or fatal personal injuries (122 persons injured), and every third direct collision (n = 188) with minor[1] personal injuries (289 persons injured) were analyzed.

We examined all police reports and hospital records, and interviewed by telephone at least one person per car, in most cases the driver.

The personal injuries were graded according to the abbreviated injury scale (AIS), where MAIS denotes maximum AIS.[7] The size of the moose (British eng.: elk) is given as calf or adult animal. A moose calf is less than one year old. A moose calf usually weighs less than 200 kg, whereas a cow weighs about 250–400 kg, and a bull weighs 250–600 kg.

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The passenger car sizes have been classified according to weight, with "small" denoting <1,100 kg, "medium-sized" from 1,100–1,450 kg, and "large" cars >1,450 kg. The percentage of cars of different sizes was 38 per cent, 53 per cent and 10 per cent, respectively.

The persons interviewed usually had a clear idea of the deformation of the windshield pillars (A-pillars) and car roof; 15 per cent had taken photographs which verified the accuracy of the answers given.

All data presented have been projected to reflect 650 accidents involving 1,309 car occupants (of whom 989 were injured). In the Figures 2–4, numbers superimposed on vertical bars denote this projected number. Sampling uncertainty ranges from ±2.5 per cent at the 5–95 per cent end to ±5.8 per cent at the 50 per cent end.

## *Results*

### Crash Situation

Collisions with an adult moose was the most common (66 per cent), while 33 per cent of the collisions involved a calf.

The center of gravity of the moose hit the car centrally in 48 per cent of the accidents; in 21 per cent, one of the A-pillars was primarily hit, and in 24 per cent the front or rear part of the moose was hit by the car; the collision point was unknown in 7 per cent of the accidents. The mean collision speed was 63 km/h for small cars, 71 km/h for medium-sized cars, and 73 km/h for large cars (for the total material; median 70 km/h, range 10–140 km/h).

### Car Deformation and Injuries

The vehicle deformation was typical for these collisions, i.e., the A-pillars were bent rearwards and downwards, the roof was in most cases pressed backwards and down, while the front and hood were fairly undamaged. The deformation of the A-pillars was most pronounced in the smallest cars and increased with increasing speed (Figure 2). The downward deformation of the roof decreased with increasing size of the car (Figure 3). The downward deformation was on average 6 cm larger in collisions with an adult moose compared to a calf in the speed interval 50–89 km/h.

Altogether, 989 persons (76 per cent) were subjected to 1,486 injuries. The majority (786; 80 per cent) suffered minor injuries; 162 (16 per cent) suffered MAIS = 2 injuries, and 41 (4 per cent) suffered more severe injuries (MAIS ≥ 3). Five persons died.

Injuries to the head and neck (54 per cent) and upper extremities (38 per cent) made up 92 per cent of the injuries. Almost all occupants suffered cuts and contusions (921/93 per cent) including 85 (6 per cent) with pieces of glass in their eyes (one person had bilateral perforations of the eye bulbs). All nine fractures of the thoracal and lumbar spine occurred in front seat occupants of small cars, as did 12 out of the 18 fractures of the cervical spine.

The deformation of the roof correlated with increasing severity of the injuries to belted front seat occupants (Figure 4). The roof was deformed rearwards to 20 cm from the seat back rest of the front seat occupant in 64 per cent of the 39 cases who suffered injuries (MAIS ≥ 3) as compared to 19 per cent of those with injuries of MAIS ≤ 2. No belted person in a large car suffered severe (MAIS > 3) injuries.

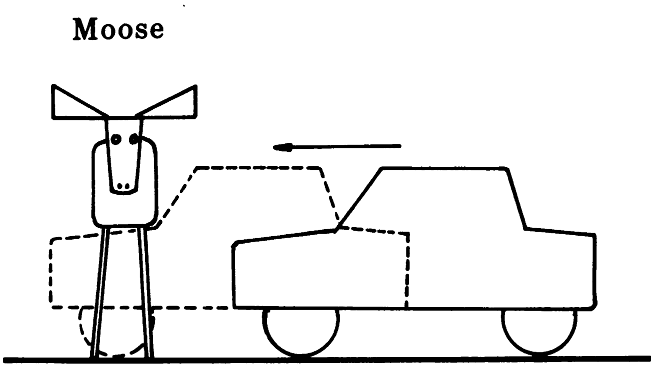


**FIGURE 1—The Collision Configuration in a Typical Direct Moose-Car Collision**

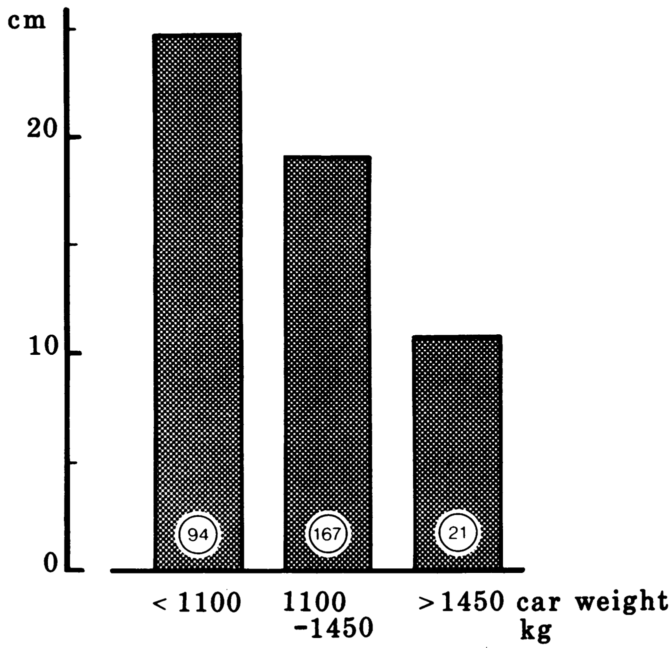


**FIGURE 3—The Average of the Maximum Downward Deformation of the Roof (cm) for Cars of Different Sizes, Standardized to Collisions with Adult Moose in the Speed Interval 50–89 km/h ($\Sigma_n$ = 282)**

*Discussion*

The deformation mechanism was fairly constant and was greatest in high speed, small car collisions with adult moose. There was a clear relationship between the deformation of the car and the severity of the personal injuries. The available compartment space thus seems to be an important factor. From this point of view, the tendency toward smaller cars with an aerodynamic and weight-reduced construction is not beneficial. With a big windshield inclined at a sharp angle the front part of the roof will be dangerously close to the heads of the front seat occupants. Weight reducing measures might in many cases mean weaker constructions, which further increases the risk of personal injuries. The so-called High Penetration Resistant windshields that are used in today's cars break into very sharp fragments which are pressed or thrown against the occupants in this type of collision. Since cuts were the most common injury, sustained by almost all injured, it seems logical to recommend a strengthening of A-pillars and roofs and the use of antilacerative windshields. This type of windshield has an inner layer of plastic protecting the occupants from fragments and splinters of glass.[8,9]

Much of our deformation data were based on interview information. It would therefore be of great value to verify our findings in comparative, standardized crash tests, simulating a central collision with an adult moose in a speed over 70 km/h. Such tests could provide information about the

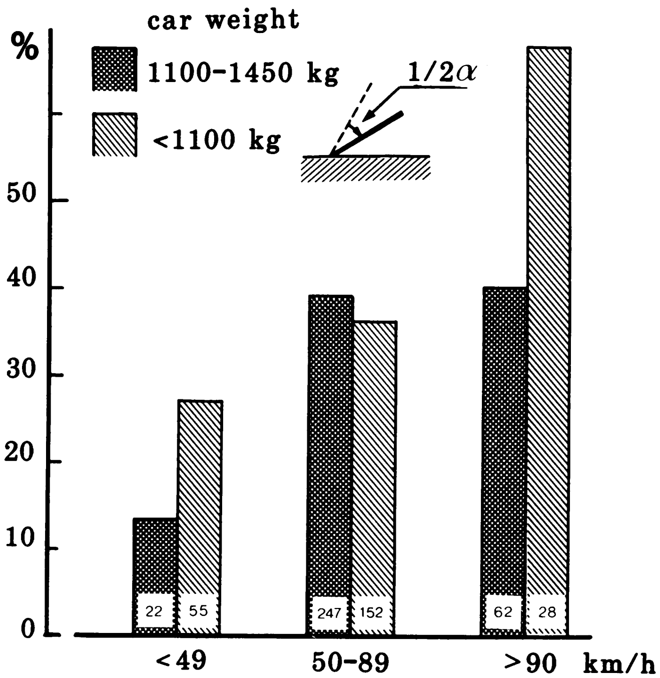


**FIGURE 2—The Percentage of Cars in which A-pillars Were Deformed to Half Their Angle (α) or More, in Different Car Sizes and at Speed Intervals ($\Sigma_n$ = 566)**
**Only 3 of 60 big cars had a deformation of half their angle or more**

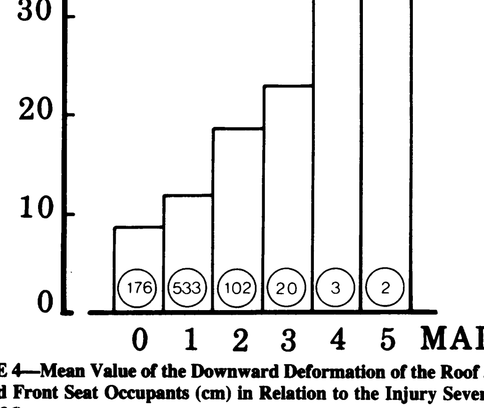


**FIGURE 4—Mean Value of the Downward Deformation of the Roof at the Place of Belted Front Seat Occupants (cm) in Relation to the Injury Severity (MAIS) ($\Sigma_n$ = 836)**

strength of different car constructions. The resulting data might constitute important consumer information.


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# Tuberculosis in Employees at a Vermont Furniture Plant

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**Abstract:** In a case-contact investigation of a patient (A) with smear- and culture-positive pulmonary tuberculosis, we found that co-workers in one room of a furniture factory had a higher prevalence of significant reactions to 5 Tu PPD tuberculin than other furniture factory workers. One co-worker also had active pulmonary tuberculosis. It was concluded that Patient A probably transmitted mycobacteria in a well-ventilated, spacious work setting; and that Patient A's disease and the subsequent outbreak could have been prevented. (*Am J Public Health* 1986; 76:462–463.)

## *Introduction*

During an investigation of an index case of tuberculosis (Patient A), an outbreak of tuberculosis was identified at a furniture plant in Vermont. We will describe this case of tuberculosis and the subsequent epidemiologic investigation to illustrate an outbreak of tuberculosis in a work setting that could have been prevented.

### Case Investigation

In 1978, Patient A and her son had extensive contact, ate meals, and spent evenings with a man who was identified as having laboratory-confirmed active pulmonary tuberculosis. During the 1978 contact investigation, Patient A and her son were neither identified nor examined. Beginning in July 1979, she had progressive symptoms of disease with cough, fever, night sweats, shortness of breath, and a 40-pound weight loss. She said that she had visited a physician on several occasions, but had never received a chest x-ray film or a tuberculin test until January 1982. At this time, she was found to be PPD positive, her chest x-ray (CXR) showed cavitary lesions in the left lung, and the smear and culture were positive for acid fast bacteria (AFB) and *M. tuberculosis,* respectively.

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Patient A had worked in one room, the finishing room (volume: 834,000 $ft^3$) of a Vermont furniture factory during her two-year employment from December 1979 to December 1981.

Another woman who worked in the finishing room of the factory was also found to have active pulmonary tuberculosis (Patient B). She had developed a productive cough in January 1982. Her sputum was also AFB smear positive and culture positive for *M. tuberculosis*. The two isolates of *M. tuberculosis* recovered from specimens from Patients A and B were sent to the Centers for Disease Control for phage typing and both were phage type 1 with an auxiliary phage type 13 using the methods of Jones, *et al.*[1]

## *Methods*

An investigation was initiated in February 1982 to determine if mycobacteria may have been transmitted to workers in the factory. A person was considered to have a positive reaction to the purified protein derivative (PPD) test if the induration was ≥5 mm to 5 tuberculin units (Aplisol*) given intradermally. Because of the reported problem with Aplisol,[2] all PPD-positive workers were retested with Tubersol* nine months after their initial diagnosis and treatment. To further analyze the transmission of *M. tuberculosis* at the factory, all employees working in the finishing room were asked to complete a questionnaire, which included questions about age, sex, job description, proximity to ventilation outlet ducts (paint spray booths), length of employment at the plant, exposure to spray chemicals, exposure to Patients A and B, and exposure to other persons with tuberculosis. We queried Patients A and B to identify their different work tasks, locations, and exposures to workers.

An investigation was conducted of persons associated with Patients A and B. Three groups of exposures were identified for data analysis. Persons with multiple exposure designations were placed in the category with greatest potential exposure; the hierarchial order was: 1) household, 2) social, and 3) face to face conversational work contact.

An environmental investigation was initiated in February 1982 to determine the air movement through the outlet ducts in the factory. Ventilating fans and outlet ducts were inspected and the escape velocity was measured by an Alnor Velometer.*

*Trade Names are for identification only and do not imply endorsement by the US Department of Human Services or the Public Health Service.